

Improvement of the quality and stability of UHT treated dairy products by enzymatic tailoring of the milk carbohydrate profile

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Aim

To show that altering the carbohydrate profile of milk by converting lactose into galacto-oligosaccharides will improve shelf stability and quality of lactose reduced UHT dairy products.

To determine to what extent changing the carbohydrate profile of milk towards an oligosaccharide rich product will affect carbohydrate-protein (glycation and subsequent age gelation), protein-protein interactions (aggregation, age gelation) and protein denaturation and subsequently what this will mean for physical, chemical and sensory properties of UHT milk and stability during transport and storage.

Taken together, the objective is to provide the Danish dairy industry with new basic knowledge that can contribute to strategies for producing high quality long life liquid lactose reduced milk products for domestic and export markets.

Description

Despite advances in UHT heating technology, aseptic packaging and process optimisation, UHT milk products suffer from instability and quality deterioration during storage. This is, to a great extent, caused by Maillard reactions wherein sugars and proteins react together, ultimately causing undesired changes in colour and flavour, loss of stability including casein micelle integrity and nutritional value. Lactose hydrolysed UHT milk is particularly vulnerable to this instability due to its high content of galactose.

Despite these challenges, UHT milk is an increasingly valuable segment for the Danish dairy industry. For example, much of the revenue from Arla Foods venture in sub-Saharan Africa (2 billion DKK by 2017) is expected to be on the back of sales of UHT milk (Dairy Reporter, Jan 2015). It is however a competitive market, as UHT technology is widely available.

The production of galacto-oligosaccharides (GOS) from lactose is a well-established process in the dairy industry. However, it is not widely, if at all, utilised in the context of direct conversion of lactose into GOS in milk. GOS are attractive dairy components from a nutritional aspect and increasing their concentration in milk may improve the quality of lactose reduced UHT milk by limiting the onset of Maillard browning. However, it is unclear how changing the carbohydrate profile of milk from disaccharides (as in regular UHT milk) and monosaccharides (found in lactose hydrolysed UHT milk), to one containing higher levels of oligosaccharides (GOS, from lactose) will affect long term storage stability and quality, in terms of flavour colour and available protein and age gelation of lactose reduced UHT milk as a whole.

The projects main hypothesis is that enzymatic conversion of lactose into oligosaccharides and suitable tailoring of the carbohydrate profile of the milk will result in improvements in quality, stability, shelf life and nutritional profile of lactose reduced UHT products